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Drag Reduction on a Circular Cylinder using Spatially Distributed Forcing JAMES W. GREGORY, CHRISTOPHER O. PORTER, DANIEL M. SHERMAN, THOMAS E. MCLAUGHLIN, Department of Aeronautics, U.S. Air Force Academy — This work investigates the use of spatially-distributed open-loop forcing for control of vortex shedding from a circular cylinder. Force-shaped plasma actuators were used to control the flow, with the aim of reducing drag on the circular cylinder at a Reynolds number of 6500. Traditional approaches to cylinder drag reduction have typically involved two-dimensional forcing of the flow field using blowing and suction. Spatially-distributed forcing, however, involves a spanwise modulation of the forcing on the flow. Kim and Choi (Phys. Fluids 17, 033103, 2005) showed in their computations that a spanwise distribution of blowing and suction significantly altered the spanwise development of vortex shedding, reduced the strength of the vortices, and reduced the drag by 40%. The current experiments implement the method of Kim and Choi with a new type of plasma actuator where the momentum addition can be directed either normal or tangential to the surface, as well as spatially tailored in a spanwise fashion to optimize control efficacy. Force-shaped plasma actuators were applied to a 2-inch diameter circular cylinder and wake profile measurements were made at several spanwise locations to evaluate the resulting drag reduction and modification of the wake structure.

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